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CASE STUDY

JCPenney: Developing Seamless Operations in a Multi-Platform Environment

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November 1996

CISR WP No. 296

Sloan WP No. 3933

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JCPenney: Developing Seamless Operations in a Multi-Platform Environment

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Abstract

JCPenney must operate a highly reliable, flexible, and cost effective computing and networking environment in order to support the needs of its 1,250 retail stores and catalogue sales business. This case study describes the operations infrastructure that the firm has developed in order to address these requirements. JCPenney is attempting to develop a single network and systems management process for its mainframe and client-server environments. IT management has articulated a clear architecture for accomplishing a seamless operating environment that centralizes and automates as much of the operations work as possible. The case is intended to help readers understand the complexities of current network and systems management, and identify issues important to the development of reliable, cost effective, and secure computing operations.

This is one in a series of case studies developed for MIT's executive education course on "Managing the IT Network for Global Competitiveness." The case study and accompanying teaching note are intended to describe and analyze one company's experiences in building and managing its IT infrastructure.



JCPenney: Developing Seamless Operations in a Multi-Platform Environment

Introduction

Committed to an information technology architecture that would provide better customer service and more accurate data capture, JCPenney started moving to a TCP/IP network environment in early 1993. By late 1995, most major transaction systems still ran in an SNA environment, but the TCP/IP network was in use at all major Penney's locations. Dave Evans, CIO, noted that the new environment offered new opportunities for IT applications, but it also presented new challenges:

All the skills, the diagnostics, the capacity planning, the trouble-shooting, the software distribution, the things that we really knew how to do very efficiently, we're now relearning how to do in this new environment. So, I guess we're catching all of the childhood diseases that come with this new environment, and it's not as smooth nor is it as efficient from an operational point of view as the one that we've been tuning up for 20 years.

Evans believed that network and systems management were critical to delivering on promises that his area made to business unit managers. He relied on John Dratch's Data Processing and Technology Support Group to design and implement an operations support architecture that provided cost-effective, reliable computing for all the company's mainframe and distributed processing.

Background

In 1913, nine years after James C. Penney had opened his first store, his company adopted the Penney Idea. This statement (see Exhibit 1) defined JCPenney's commitment to the well-being of its customers and employees. By 1995, the company owned and operated 1,250 retail stores in the U.S. and Latin America, but the Penny Idea continued to define its key values.

JCPenney, which specialized in men's, women's, and children's clothing, and home furnishings, had sales in 1995 of over \$21 billion, including \$3.8 billion in catalogue sales. Sales and Catalog were the two largest of Penney's eleven business divisions, which included a drug store operation, life insurance and a large credit organization. Penney's employed 200,000 associates, the majority of whom were part-time sales associates.

Despite spending less than the industry average on IT, JCPenney had traditionally been a technology leader in its industry, and Penney's associates had come to depend on technology for business solutions. For example, Penney's was a heavy user of EDI, exchanging over 95 million electronic

This case was prepared by Jeanne W. Ross at the MIT Center for Information Systems Research. It may be freely distributed to students in not-for-profit educational institutions.

documents in 1995, and Penney's buyers around the world had on-line access to management information and design graphics. Evans attributed the technology leadership to a series of top management teams that recognized the importance of IT:

We've been lucky in that every chairman we've had for the last thirty years has been a great promoter of technology, going back to Milt Batten, who was in the '60s, when we were first learning how to do point-of-sale. We've only had four chairmen in that time, but every one of them has believed that you have to invest in these things, keep up-to-date, take a leading position in the industry. That sets an atmosphere for acceptance, which is certainly better now than it was thirty years ago. I like to say now that people think of systems as something we do *for* them; they used to think of it as something we did *to* them.

Evans noted that the migration to newer technologies was expensive. It took both top management commitment and the availability of financial resources to make it happen:

We've had a major period of technical transformation since 1987-88. During that time, we've had a very strong balance sheet. When many of our competitors were in bankruptcy court, we were in TCP/IP class. We were able to invest consistently through this period, right through a recession in 1991 and 1992, with hardly any slowdown. A strong balance sheet is really one of the things that enabled this rather rapid transformation of a pretty large network.

Information Systems at JCP

JCP had a highly centralized information systems organization. With computing capabilities encompassing 60,000 POS terminals and 100,000 other electronic terminals in 4,000 different physical locations around the world, responsibility for the firm's 2,500 mainframe Mips, 10 terrabytes of storage, 1000 servers, 48 Tandem Cyclone processors, and six AS/400 specialty retail systems was all centralized under Evans. IS had five units (see Exhibit 2). Two units, Personnel and Security, and Accounting and Control, were small staff units. Systems Development was staffed by 600 applications programmers who developed business systems. Communications provisioned lines for voice and data communications. Data Processing and Technology Support, which was headed by John Dratch, was responsible for infrastructure development, deployment, operations and support.

Data Processing and Technology Support totaling 500 associates was comprised of seven subunits, the largest of which was the Operations organization. This subunit operated and managed the computing and technology infrastructure for the entire company. The Technology Support organization was responsible for asset management, equipment evaluation, capacity planning, software distribution, and troubleshooting and an Advanced Technology Group studied emerging technologies and their applicability to JCPenney. A small Strategic Planning group studied functional requirements within IS and examined and recommended hardware and software technologies which would improve effectiveness and efficiency of the data processing technology operation and infrastructure. The Root Cause Analysis Team identified and attacked the root causes

of recurring problems. An Operational Support Team focused on procedures, audits, and disaster planning and recovery. The Quality and Customer Services unit spearheaded continuous improvement for the organization and customer liaison activities to insure quality services were provided.

The migration from SNA to TCP/IP and the increasing use of departmental servers presented a complex management environment. Contributing to the complexity was the need to convert token ring to ethernet, prepare for frame relay and ATM, and sort out confusion among competing relational data base technologies (DB2, Oracle, Informix, Sybase). At the same time, the user community had developed higher expectations for functionality and greater interest in handing over responsibility for their technology to the IS unit.

Dratch noted the potential for the complexity to lead to climbing headcounts and inefficient operations. To provide cost effective operations and support, he established a vision for a seamless operation in a multi-platform environment:

We said to ourselves that what we really need to do is create an environment in the Penney Company that enables us to embrace all the different platforms and the technologies in a disciplined way as if it was a single logical production environment — very efficient, well run, well disciplined.

To enable this vision, Penney's consolidated operations at its four data centers into a single command center in Dallas, called the Information Technology Control Center (ITCC). Staff in the ITCC manned the help desk and controlled lights-out operations in the Reno, Kansas, and Columbus data centers, which handled most mainframe processing. These three data centers, as well as a data center in Dallas that was used primarily for test and development, received messages and alerts from each other, so they could provide backup as needed. The ITCC was at the heart of Dratch's plans to develop a single set of processes and procedures for computer and network operations and support at JCPenney, using its foundation rules-based automation systems.

The Information Technology Control Center (ITCC)

Reminiscent of NASA's command center in Houston, the ITCC was located in a large room in which staff occupied seven long rows of workstation-equipped furniture, all facing four large screens that highlighted the status of key systems and components. (Exhibit 3 depicts the role of the ITCC.) Distributed hardware and software were monitored by rules-based automation management systems that generated alerts and messages when they did not function to specification. The rules-based management systems either automatically provided a resolution or forwarded messages and alerts to ITCC staff members who diagnosed problems and issued commands to resolve them. At the same time support people captured data on volume and bottlenecks. They provided real time resolutions and adjustments through performance tuning parameters; the data were then passed on to capacity planners for problem analysis and capacity projection updates. ITCC staff also interfaced with application developers, vendors, and customers, any of whom might provide changes or requests for help. A key role of the ITCC was to integrate the requirements and changes arising from each of the three sources: the hardware and software, the support teams, and the applications developers.

ITCC responsibilities were addressed by four different kinds of technicians. The first two rows of operators were dedicated to help desk operations. Help desk staff received calls through a communications front end that captured the calling number and checked it against a database to identify the caller. It then displayed his or her technology configuration on the operator's terminal. When the caller reported a problem, the help desk operator opened an incident report that was recorded in the InfoSys database. For a narrow range of problems, help desk operators could make the fix. Typically, they channeled problems to one of four or five sources, based on whether they appeared to be computer problems, network problems, or programming problems. When technicians fixed problems, help desk operators followed up with callers to check that everything was working properly.

The third row in the ITCC was responsible for problems reported automatically by the automation management system. Personnel in this row functioned like systems operators in a traditional console environment. They were primarily responsible for determining the source of problems and channeling them to appropriate problem solvers when they could not be resolved.

Problem solvers occupied the next three rows in the ITCC. They attempted to restore service when there were network or computer problems. When they could not solve problems, they would escalate them to agent specialists in other units, such as the hardware and network vendors or a team of advanced information technology specialists. They would record any action they took in the same InfoSys database that help desk operators used when the problem was reported.

The ITCC received approximately 54,000 help desk calls each month and opened 36,500 incident reports (IRs). The IR database provided data on the kinds of errors that were causing failures and IS used the data to identify common cause areas needing work. They also tracked statistics so that they could measure their improvement in reducing the number of IRs. IS distributed monthly status reports to business unit heads that indicated the number and percentage of IRs that affected their business unit. These reports fueled discussions of systems development priorities.

The ITCC operated 24 hours a day, 7 days a week. Staff in the ITCC worked twelve-hour day or night shifts alternating between three and four days a week. The help desk operator was an entry level position. With training and experience, individuals could progress from this position to console operators and then problem solvers. Some then moved into technical roles outside the ITCC.

John Dratch believed that a single management system, that integrated across technology platforms, was essential to the efficiency and effectiveness of the ITCC. Six disciplines— Capacity Planning, Change Control, Scheduling, Automation, Problem Management, and Network Management—operationalized the single system concept. These six disciplines defined the key IS operations and support activities that were captured in the model in Exhibit 3. Capacity planning was a support unit initiative. Scheduling and automation activities emanated from the hardware and software. And the interface constituencies (developers, users/customers, and vendors) initiated change control and problem management. Network management activities could arise from any of the three endpoints.

Capacity Planning

Capacity planning was an important discipline because growing ad hoc use of query-based applications and communications capabilities led to more volatile patterns of resource utilization, while the dispersion of processing power presented increasing numbers of devices where bottlenecks could occur. Technical support staff responded to this challenge by collecting detailed information about system use that allowed them to track trends.

Key to the planning effort were the annual forecasts of prime business units from the eleven Penney's divisions. Prime business units represented the drivers of computer activity in each division. For example, in payroll, headcount was a prime business unit; in catalogue, a prime business unit would be number of orders written or dollars of demand. In order to use this information for forecasting, each computing platform kept a running history of resource utilization for jobs that ran on it. This allowed IT to convert prime business units into resources consumed and to track trends over time. Modeling systems from BGS, Best/1, Capture, and Visualizer Tools estimated processing requirements, while tools from BGS, Legent, and Sterling estimated storage requirements.

Change Control

JCPenney instituted about 100,000 changes a year in the form of changes to existing systems, implementation of new systems, installation of new hardware or software, changes in the environment, or shutdowns. These changes could come from any one of 34 identified change agent groups—ranging from the company's 600 applications programmers to external hardware and software vendors. To ensure that a change proposed by one change agent would not conflict with the operations or change initiative of another agent, all change agents input the proposed changes into the online control system, indicating the nature of the change and when they would like it to occur. Associates responsible for change control checked for incompatibilities and conflicts and either accepted or rejected each change. Accepted changes were released into the system and would—automatically be executed as scheduled. Rejected changes were returned through the system to the originator with an explanation of the conflict they would cause. They could be restaged on a different schedule. The change management system automatically notified originators when changes had taken place.

The change management system was homegrown and produced an audit trail that allowed IT management to refer to recent changes when analyzing system failures. Physical changes, such as a new CPU, power system, or UPS, were manually input into the change system to provide a complete audit trail, which focused attention on likely causes for unexpected crashes or processing problems. The system also provided security for corporate assets by separating creation from installation of all changes.

Scheduling

JCP ran approximately 15 million jobs a year according to a thousand unique schedules. Although these jobs increasingly ran on dispersed processors, JCPenney attempted to keep scheduling centralized to better control the scheduling function and more easily respond to the need to revise schedules due to hardware and software problems. ESP, a scheduling package from Cybermation, allowed the Operations group to automate 99.4% of the firm's job scheduling by specifying times and rules for running batches. ESP ran jobs based on time requirements and prespecified

dependencies between jobs. It detected failures and reported system crashes caused by applications code to the automation system.

Automation

The computers at JCPenney generated 2.5 million daily alerts and messages on the status of jobs they ran. To most efficiently identify those messages that required human intervention, Penney's Data Processing and Tech Support group attempted to automate as many of the responses as possible and to notify operators of the need for their services through exception reporting.

Automation was rules based. Whenever the computer put out an alert or message, the automation system referred to a customized data base that specified the action that should be executed. When the system was installed in 1993, it handled 93-94% of all messages. By late 1995 it provided automatic responses to 97% of the 2.5 million daily alerts. The approximately 75,000 alerts and messages for which there was no match on the database required manual interaction with automation staff who continued to add solutions to the database.

ESP could identify problems that resulted from poor applications code. In those cases, the automation system referred to a table of beeper numbers which were associated with each application job. If a job failed, it was the responsibility of the person with the beeper to resolve it. Beepers were passed around so that all applications were covered at all times. The beeper put out 250 characters on the nature of the problem so that the responsible individual could determine its urgency.

The automation capability was provided by Legent's Automate family of products. It was platform-based, so that messages coming from any platform could be handled at the source. Rules databases for each platform provided the logic for resolving most problems automatically. When a failure was detected, the management system activated the centralized problem management system and opened an incident report. The system operators in the third row of the ITCC responded to these exceptions.

Automated Problem Management

A key concern of IS management was the ability to provide fast, competent support to IT users throughout the firm. JCPenney's help desk received 350,000 calls per year and IS focused on processes that would help it quickly escalate all problems to someone who could resolve them. The key to the automated problem management system was an InfoSys database that tracked each call from the time it was received, through all attempts to resolve it, to its eventual resolution and sign-off by the caller.

While computer-reported problems automatically opened an incident report, help desk staff opened incident reports generated by user calls. These incident reports were held in the InfoSys database, which both inventoried outstanding problems and provided the human interface for individuals who needed to know the nature or status of a problem, and the kinds of action that had been taken on it. Help desk staff escalated problems to appropriate ITCC technicians who solved the problem or, when they could not, prepared work lists for technical specialists who could fix them. The technical specialists updated the database as they worked on problems. The system could then fax out status reports in response to inquiries on open problems.

Network Management

The network management system was the toughest component to tie into the automated problem management system. JCPenney had been moving to a TCP/IP architecture, but approximately 80% of its environment was still managed by SNA. In 1995 no single network management product managed both the mainframe and distributed environments. Thus, the firm relied upon multiple Element Management Systems (EMSs) to manage various networking technologies. The EMSs employed included: NetView to manage SNA, OpenView to manage TCP/IP, TNM-6000 to manage IDNX circuits, ComSphere 6800 to manage DSUs, and the Paradyne 5530 Analysis System to manage analog modems. It was developing code internally to create a single source for all network alerts.

In addition to merging the management systems for the major computing environments, network management involved monitoring and troubleshooting all the devices on the network. Traditionally, each major kind of device had its own management system. For example, Penney's used Paradyne to manage its modems. It had separate management systems to manage devices like routers and DSUs. The challenge presented by the management systems for the individual devices was that each management system tended to monitor the entire network. As a result, tying them into the automation system in addition to NetView and OpenView generated multiple alarms when something went wrong:

You could have a modem down here, so the line it's connected to doesn't work because the modem is broken and the device on the other end of the line doesn't work because the line isn't working. Is it the modem that's broken or the line that's broken or the device that's broken? You get three alerts coming up. So which one do you chase? (John Dratch)

Bob Andrzejewski, Project Manager in Communication Support, explained the limitations of current network support:

When a router goes down out in the network, we want to capture that alarm, do some automation, forward that alarm, and get an incident report (IR) out in front of the problem solver. We can do that, but we open up too many IRs.

Andrzejewski noted that generating multiple IRs for a single problem meant that excess resources were applied to troubleshooting:

It becomes very labor-intensive. If you open 50 IRs, you could have 50 people working on the same problem. An event correlation engine was required.

Increasing automation of network management required end-to-end connectivity. Consequently, Andrzejewski's team was developing a configuration database that would map all network components and sort through multiple alerts to determine the source of a problem. A fully developed configuration management system interacting with the automatic problem management system would eventually enable very efficient network management. The configuration management system would identify which device was most likely at fault when multiple alerts were generated. Then the

automatic problem management system would check a rules database that dictated how it should be resolved—whether that solution was automated or manual.

Developing the configuration database was a time-consuming effort that started with identifying the location of all network components. This information existed in various places in JCPenney, such as with the Communications unit or at the individual stores. Collecting the information from these sources for purposes of developing a single database required changes in how individuals collected and accessed information that was important to them, so Andrzejewski's team would need to sell each individual on the value of the database. Once the data were collected, the team would need to understand and capture the relationships among the components in the database. They would also need to develop methods for constantly updating the database.

While waiting for the configuration database to support increased automation of network management, ITCC staff could use graphical maps to help them monitor the networks. The maps highlighted the parts of their networks that were out of commission, which could visually help locate the source of a problem, but they could not pinpoint specific problems and solutions:

And the question is, do you want to give the technicians too much information that they have to sort through so you can service the customer now, or do you want to wait until you get the Cadillac solution and you're stuck with people calling in and saying, "Hey, something's wrong!" when you could have known about it? It's a real quandary. Do you flood the technicians, and get the problem now, or do you wait and have them call you?
(John Dratch)

Quality Initiatives

IS's concern with continuous improvement of operations and support was articulated in the Data Processing Quality Initiative. This initiative was guided by five quality tenets (and accompanying measures): assurance (efficiency), tangibles (effectiveness), reliability (consistency), responsive (responsiveness), and empathy (satisfaction). (The tenets and measures are described in Exhibit 5.) The five measures were each composites of many individual measures (over four hundred total measures existed in early 1996) that had been automated and were constantly tracked by the Data Processing organization. The tracking applied principles of statistical quality control and charts were available via an intranet to all Penney's associates. "Out of control" measures generated electronic mail messages with a control chart to the owner of the measure. Several procedures associated with the development of the ITCC supported JCPenney's quality initiative. These included (1) morning meetings to review unresolved technical problems; (2) incident report tracking and database mining; and (3) IS customer service representatives.

Morning Meetings

Every morning at 8:00 John Dratch met with his management team and their direct reports, as well as vendors and internal customers to do a twenty-four hour shift turnover. The meeting typically lasted about 15 minutes and was conducted via video conferencing to include associates at headquarters (which included the ITCC) and specialists in the Advanced Information Technology Group based at the data center in a different part of Dallas. The discussion focused on reviewing the

prior day's action items, open incident reports and recurring problems. Each day participants clarified responsibility for follow-up.

A summary of the meetings was provided on both e-mail and voice mail for IS managers who were not present. Dave Evans, the CIO, commented on the usefulness of these meetings:

They publish a report every day on e-mail between 9:00 and 10:00 in the morning. I look at it and usually I don't do anything except file it, but I might have a question about some particular item and I can shoot off a question about it. The operational part of my job is a fairly small percentage, but I do that every day.

Incident Report Tracking

The InfoSys database provided a record of all incident reports (IR). IS used this both to identify recurring problems and to measure its progress in reducing the number of technology problems over time. A one-page monthly summary for each business unit identified the IRs associated with their systems or called in by their users. The IRs were tallied according to their source: batch, operating environment, or user-reported, and totals were reported for the entire firm as well as for the specific business unit (see Exhibit 4). IS and business unit managers could use these tallies to identify systems that should be rewritten and users who needed training or new desktop capabilities.

IS Customer Service Representatives

The Data Processing and Technology Support unit had six customer service representatives who worked with the business divisions to communicate IT capabilities to the businesses and to represent business unit needs to IT. Their roles involved a great deal of communication with the goal of increased understanding and more effective development and use of IT resources. Dratch described the customer service role as follows:

He acts on the customer's behalf for any kind of problem or service. He'll work through the applications people and the operating people. He speaks our language; he speaks the customer's language.

Outcomes and Next Steps

JCPenney's automation and discipline enabled it to reduce computing costs below the industry standard. Most of the savings resulted from reducing the headcount required for infrastructure support from 800 to 500 associates, which resulted in an annual savings of \$11.5 million. By late 1995, Dratch's organization had eliminated most repetitive tasks, automated action on 97% of the 2.5 million messages and alerts generated each day, enabled automatic opening of incident reports in 95% of the cases, and improved effectiveness and efficiency.

New network technologies and initiatives would continue to challenge the operations and support teams. For example, the firm was expanding its access to Internet technologies, particularly its use

of intranets. Dave Evans noted that the initial use of intranets was to improve communications with the stores:

We have an accounting manual, a merchandizing manual, a personnel manual, a security manual. And when we finish those we have another big audience—there are 5,000 suppliers out there and a stack of manuals for things like EDI, invoicing instructions, packaging instructions, stitching instructions...

Evans noted that Penney's would have at least three different webs: one for associates, one for suppliers, and one for connections with customers. The webs would take advantage of the TCP/IP networking capabilities that Penney's had installed, while introducing new security and management issues.

Dratch's organization would continue to move toward automated support by, among other things, expanding management of UNIX and NT environments, absorbing new processors (e.g., SP2 and CMOS), adding management of AS400 and VM, and upgrading desktops to Windows 95. They would continue to work toward the objective of a single management system in order to minimize cost and maximize quality in an increasingly complex computing environment:

When you buy OpenView, put it on the table and let it handle Openview, and then get something to handle MVS and it's handling just MVS, and something for AS400 supporting just AS400, it forces too many systems. Our solution is to have Openview open up an incident report in a common system. So it's easy for us to change our products. You've got a scheduling product, you've got a capacity planning product, you've got a network product, you've got an InfoSys product. Every one of those can move on their own because they become part of the operating management system which all platforms talk to.

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Exhibit 1

The Penney Idea

- ◆ To serve the public as nearly as we can to its complete satisfaction.
- ◆ To expect for the service we render a fair remuneration, and not all the profit the traffic will bear.
- ◆ To do all in our power to pack the customer's dollar full of value, quality and satisfaction.
- ◆ To continue to train ourselves and our associates so the service we give will be more and more intelligently performed.
- ◆ To improve constantly the human factor in our business.
- ◆ To reward the men and women in our organization through participation in what the business produces.
- ◆ To test our every policy, method and act in this wise: "Does it square with what is right and just?"

Adopted 1913

Exhibit 2

JCPenney Information Systems Organizational Chart

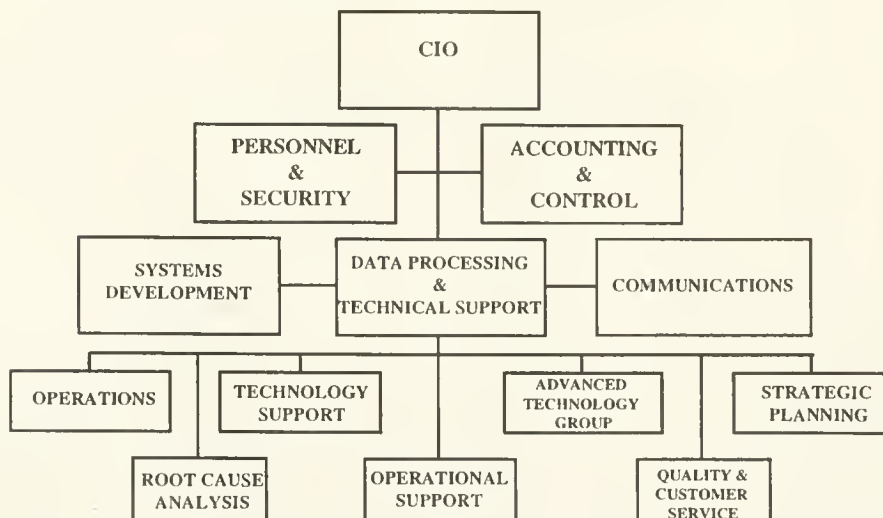


Exhibit 3

JCPenney Systems Support Model

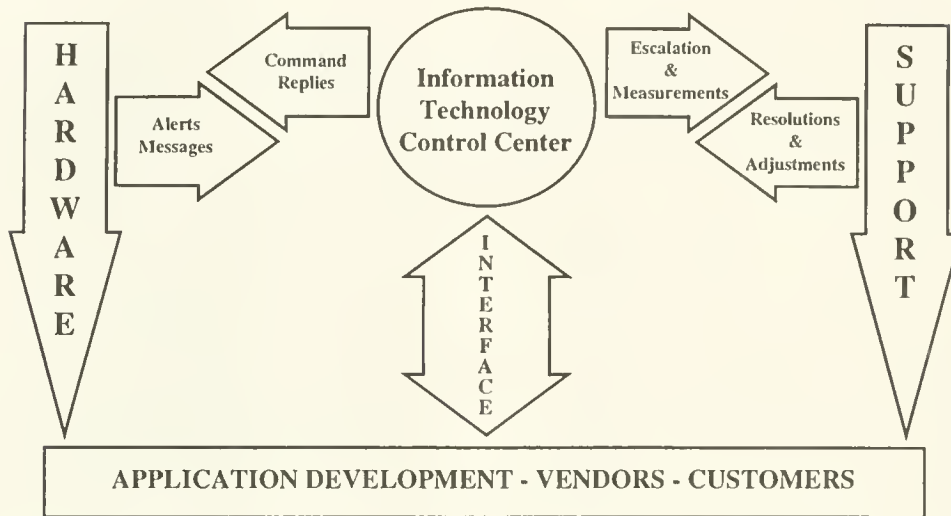


Exhibit 4

Monthly Incident Report Summary

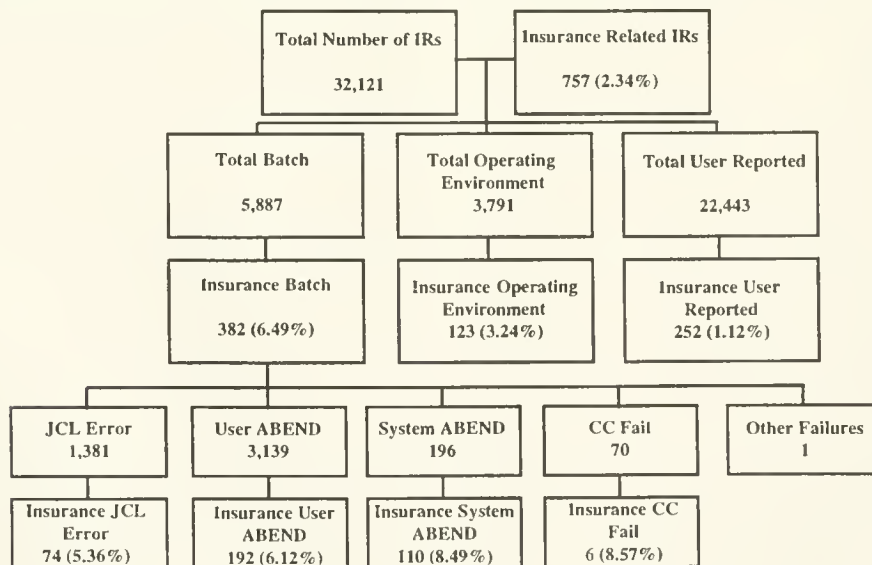
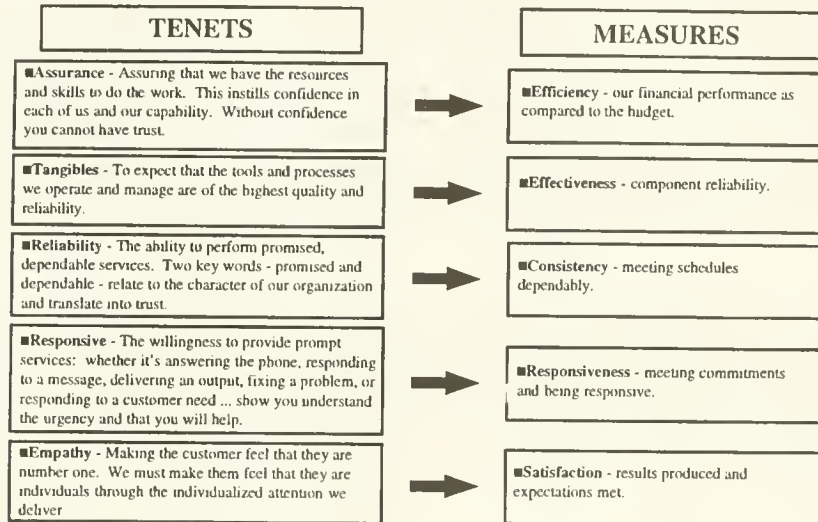


Exhibit 5

JCPenny Quality Initiative



JCPenney: Developing Seamless Operations in a Multi-Platform Environment

Teaching note

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The JCPenney case describes the infrastructure that the firm has developed in order to efficiently and effectively manage its distributed computing environment. The firm is attempting to develop a single network and systems management process for its mainframe and client-server environments. IT management articulated a clear architecture for accomplishing this goal and has selected products and done in-house development to develop the necessary tools and platforms. The case is intended to help readers understand the complexities of current network and systems management and identify the issues they must address in order to establish reliable, cost effective, and secure computing operations.

The case was developed for an executive course on network management. It will also be useful for undergraduate and graduate information technology students. Although the technical detail, particularly the identification of specific products, is greater than they need, they should find it interesting to note the number and variety of products required to manage a large-scale computing environment.

Recommended Discussion Questions

1. Describe the systems and network management function at JCP. What are the primary concerns?
2. JCPenney has a highly disciplined operations management environment. What has made this possible? How appropriate is the architecture it has developed? How appropriate would it be for other firms? Discuss key choices and identify alternatives.
3. Discuss the ITCC. What are its critical success factors? What alternative designs might make sense?
4. JCP has invested considerable resources in operations management. It is unlikely that any of the related expenditures have a direct impact on JCP customers. How might the firm justify this investment?

Class Discussion

I. Overview of network and systems management

For most classes, the primary discussion of the case will focus on developing an understanding of the infrastructure management function in an organization. Note that the case lists the primary responsibilities as they are perceived at JCP: capacity planning, change control, scheduling, automation (systems monitoring), problem management/trouble shooting, and network management. These are important concerns in any large-scale computing environment. It is useful to have students

list why each is important and what kinds of problems a firm could encounter if the responsibility is not performed well. A list might note the following:

Capacity planning: ensuring that enough processing power and network bandwidth is available as needed. This has become particularly challenging as on-line queries become a bigger part of a firm's computing and as Internet and World-Wide Web access experience exponential growth. Sufficient capacity is important to provide acceptable response times. As prices for both bandwidth and processing power decrease, firms are increasingly inclined to plan for excess capacity as protection against shortages. But this does not make capacity planning easy. Growth in the use of computing and communications technologies has not been linear, so it is difficult to anticipate.

Change control: Constant additions, deletions, and changes to a firm's computing assets make it difficult to monitor the impacts of individual actions on an entire system. This has become a particularly messy problem as firms allow remote locations to manage their local area networks but connect the LANs to the firm's wide area network, where local changes can have unforeseen consequences. For example, an improperly assigned internet address can bring down an entire system in a remote location. Many firms address these issues through standard operating procedures. Penney's has decided to attack it by centralizing control and limiting access.

Scheduling: Despite the growth of on-line systems, many firms still run large numbers of batch jobs. This is usually automated through a purchased software package, as described in the case. Distributed computing environments will again complicate the environment, however, if jobs are scheduled locally but require access to mainframe data or processing power.

Automation (systems monitoring): Automation has eliminated the tedious work of the systems operator who monitored console output that recorded job starts and ends. Penney's 2.5 million daily alerts makes it easy to understand why automation that allows management by exception is important to management efficiency. It is also easy to understand why JCP is attempting to reduce the number of alerts (currently 75,000 each day) that require personal attention. They are primarily concerned with identifying failures, but they need to automate responses to all other alerts to ensure that all failures are identified.

Automated Problem Management: This refers to the electronic database and related processes used to support Penney's help desk function. Help desk technicians answered calls and determined, in most cases, who could address them. Only occasionally did they solve the problems themselves. Some firms choose to put more technically competent individuals on the help desk. Note that JCP chose to use the help desk as an entry level position. The help desk was as much a training ground for IT staff as it was a service to Penney's internal IT customers. The InfoSys database helped accumulate the learning that was possible from help desk calls.

Network Management: Network management has become particularly challenging and important due to the growth of distributed computing. While computing tasks are often completed on the desktop, many, if not most, require access to a network. When the network is down, individuals often find themselves unable to complete their work. In some industries such as financial services, catalog sales, and transportation, business nearly grinds to a standstill if the network goes down. Network failures of a significant amount of time can cost firms millions of dollars in revenues. Thus, network

management is critical. It involves monitoring all the networks as well as all the devices connected to the network. As noted in the case, it is easy to observe when a network and/or devices on that network fails, but usually one failure impacts neighboring devices. Current monitoring technologies are usually not sophisticated enough to isolate the source of a problem. This is why John Dratch is struggling to decide what to do when the source of a failure is unclear. He can send out multiple alerts and put too much manpower on a problem or send out no alerts and wait until a customer calls to complain.

II. Network and Systems Management at JCPenney

The second part of the class discussion can focus on Penney's decision to centralize essentially all aspects of the systems and network management function. Students should observe that this is a very neat architecture — everything comes back to the center. It is a simple architecture to articulate but requires a great deal of will and, in most cases, a centralized organizational culture to enable it. JCP has eight business units but operations are dominated by the 1250 stores. Thus, it feels very much like a centralized business. Philosophically, it is reasonably easy to argue that JCP should organize its computer operations centrally. Not all firms are comfortable with this organizational design, despite the fact that it is likely to be the most cost effective way to manage computer operations. Where different business units have few synergies, however, centralizing computer operations has significant disadvantages.

Many firms keep help desks at local sites so that help desk technicians can provide hands-on support for their clients. Some have more distributed change control processes, which rely more on the cooperation of operations' managers at remote sites. JCP had the option to take a less centralized approach, but the centralized unit made sense given organizational structure and processes.

It is worth noting that JCP invested significant resources into infrastructure management. It is also worth noting that several unique characteristics about the firm made this possible: centralized operations environment, top management commitment to IT and its management, very competent IT managers, years of experience with a disciplined approach to IT operations while still in a mainframe environment, strong financial position as a firm with sufficient resources allocated to IT. Firms with fewer resources or less commitment on the part of senior management may not be as successful in generating funding for initiatives targeted at reducing the cost of systems operations.

III. The ITCC at JCPenney

The ITCC is the key component of JCP's operations management architecture. A number of critical success factors make it a success. First, Penney's commitment to the concept resulted in a state-of-the-art facility, which likely provides a satisfying work environment. Although the room can be somewhat dark (for purposes of more easily viewing the screens of data in the front of the room), it is an impressive and comfortable looking room.

A great deal of attention has been paid to the needs of ITCC employees. Career paths and opportunities for advancement have been clearly enumerated. Three-day and four-day twelve-hour shifts (rather than five eight-hour shifts) appeal to many of the workers, who appreciate both the predictability and the flexibility of having a short work week. Finally, the technology support and

organizational processes supporting the workers make it possible for the employees to feel competent in their work. The technologies help train them even as they walk them through their jobs.

Another aspect of the ITCC that has contributed to its success are the efforts towards continuous improvement. Incident report tracking clarifies performance goals for the associates and alerts management to potential problems. It identifies needs for new systems or for associate training. These clear goals help focus both management and associate efforts to provide high quality support for JCP systems.

IV. Investment in ITCC Technology Support

Unlike external customer-oriented systems support, investments in infrastructure management technologies require a return on investment that is usually based on cost reductions. The calculations of the return on such an investment are straightforward ROI or payback analyses. It can be difficult, however, to identify, in advance, what a system will cost to develop or install. It is also difficult to anticipate actual head count reductions or reduced systems failures. Penney's experience in both its prior management environment and with the ITCC help with those estimates. Even with top management support, JCP invests sparingly in new technologies for the ITCC.

V. Conclusion — Transferability of the JCP model

Class discussion might close by considering all the factors that must be in place in order to have really effective network and systems management in a firm. Clearly, technically competent staff are a prerequisite as are effective project managers who can develop and implement the technology support needed to make it happen. Competent staff must have the confidence of business management in order to secure the funding to invest in infrastructure and operations support technologies. Note the role of the customer service representatives in sustaining that trust and confidence. Finally, the firm needs a clear vision of how operations will be managed. Many firms lack a well-articulated vision for how IT operations will be managed. Responsibility for the key network and systems management functions must be assigned, and processes for carrying out those responsibilities must be clearly communicated and enforced. The JCP architecture should not be viewed as the appropriate approach for every firm, but its clear vision and focused efforts for fulfilling that vision serve as a useful model.

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